PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1841. No. 30.

June 14.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

James Patten, M.D., was elected a member of the Academy.

Dr. Aquilla Smith read a paper "On the Irish Coins of Henry VII."

In the preliminary remarks, the author entered at some length into the history of the Irish coinage during the reigns of Henry V. and Henry VI., with the view of facilitating his inquiries in the subsequent part of his essay. And from the evidence of several Acts of Parliament, which were not known to previous writers on the coinage of Ireland, he inferred that no legal money was coined in this country by Henry V., and that very few coins are known which can be appropriated to his immediate successor.

The coins of Henry VII., which are very numerous, were divided into three sections, each distinguished by the form of the cross on the reverse; and in the last section the author supported Mr. Lindsay's appropriation to Henry VII. of the untressured groats which Simon had given to Henry V.

Rev. H. Lloyd, V. P. read a "Note on the Mode of observing the vibrating Magnet, so as to eliminate the Effect of the Vibration."

The following modification of one of the methods proposed by Gauss, for the attainment of this end, appears to combine the greatest number of advantages; namely, *to take three readings, at the times*

$$t - \mathrm{T}, \quad t, \quad t + \mathrm{T};$$

t being the epoch for which the position of the magnet is desired, and T *its time of vibration.** In order to show that this method is adequate, it is necessary to deduce the equation of motion of a vibrating magnet in a retarding medium.

Let X denote the horizontal part of the earth's magnetic force; q the quantity of free magnetism in the unit of volume of the suspended magnet, at the distance r from the centre of rotation; and θ the deviation of the magnet from its mean position. The moment of the force exerted by the earth on the element of the mass, dm, is

$$\mathrm{X}qrdm \sin\theta;$$

and the sum of the moments of the forces exerted upon the entire magnet is

$$\mathrm{X}\mu \sin\theta;$$

where μ denotes the value of the integral $\int qrdm$, taken between the limits $r = \pm l$, $2l$ being the length of the magnet.

Again, the velocity being small, the resistance may be assumed to be proportional to the velocity. Accordingly, if ω denote the angular velocity, the retarding force due to resistance, upon any element of the surface, ds, at the distance r from the centre of motion, is

$$- \mathrm{K}ds\, r\omega;$$

and the entire moment of this force upon the whole magnet is

* In practice, it is sufficient to take the nearest whole number of seconds, for the value of T.

$$- \text{K}\omega \int r^2 ds = - \text{K}\omega \int \frac{r^2 dm}{\text{H}};$$

where $\text{H} = \frac{dm}{ds}$. The ratio, H, is constant for all bodies of prismatic form; and for these, therefore, the moment of resistance is

$$- \frac{\text{MK}}{\text{H}} \omega;$$

M denoting the moment of inertia $\int r^2 dm$.

The differential equation of motion is, therefore,

$$\frac{d\omega}{dt} = \frac{\text{X}\mu}{\text{M}} \sin\theta - \frac{\text{K}}{\text{H}} \omega.$$

But $\omega = - \frac{d\theta}{dt}$; and, θ being small, we may substitute θ for $\sin\theta$. The equation thus becomes

$$\frac{d^2\theta}{dt^2} + \frac{\text{K}}{\text{H}} \frac{d\theta}{dt} + \frac{\text{X}\mu}{\text{M}} \theta = 0.$$

Making, for abridgment, $\frac{\text{K}}{\text{H}} = 2\text{A}$, $\frac{\text{X}\mu}{\text{M}} = \text{B}^2$, the integral is

$$\theta = (c \cos \sqrt{\text{B}^2 - \text{A}^2}.\, t + c' \sin \sqrt{\text{B}^2 - \text{A}^2}.\, t)\, e^{-\text{A}t}.$$

But, A being small, we have approximately

$$e^{-\text{A}t} = 1 - \text{A}t;$$

and, if T denote the time of vibration,

$$\sqrt{\text{B}^2 - \text{A}^2}.\, \text{T} = \pi.$$

Hence the preceding equation may be put under the form

$$\theta = (1 - \text{A}t) \left(c \cos \pi \frac{t}{\text{T}} + c' \sin \pi \frac{t}{\text{T}}\right).$$

Now, let $\theta_{,}$ and θ' denote the values of θ, when t becomes

$t - \text{T}$ and $t + \text{T}$. It will be seen at once, on substitution, that

$$\theta_{,} + 2\theta + \theta' = 0.$$

Hence by combining the three readings according to the preceding formula, the deviation of the magnet from its mean position, arising from the vibratory movement, is completely eliminated; and it will readily appear that the same result may be attained by any greater number of readings, taken and combined according to the same law.

Now, let the value of θ contain an *additional* term, $+pt$, proportional to the time: or, in other words, let us suppose that there is a *progressive* change of the declination, which may be regarded as *uniform* during the whole interval of observation. It is then manifest that $\theta_{,} + 2\theta + \theta' = 4pt$; and accordingly that the quantity

$$\tfrac{1}{4}(\theta_{,} + 2\theta + \theta')$$

will give the mean place of the magnet corresponding to the epoch t.

The supposition of a uniform change can, however, be regarded as an approximation to the truth, only when the interval of time between the first and last reading is very small, in comparison with the interval between the successive maxima and minima, in the fluctuations of the irregular movement. Hence, we may conclude, that it is important, in the first place, to employ three readings in preference to any greater number; and, secondly, that it is desirable that the time of vibration of the magnet itself should be as small as possible, consistently with the accuracy of its indications in other respects.

Professor Lloyd read the following extract of a letter from the Rev. George S. Smith, containing some facts relative to the storm of May 26th and 27th.